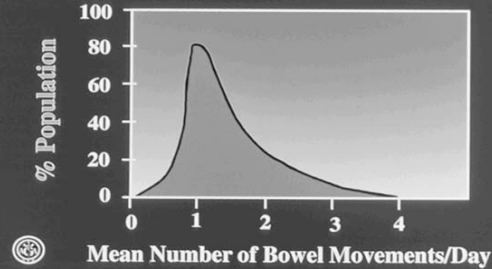


Diarrhea

Donald P. Kotler, MD
 Chief, GI Division
 St. Luke's-Roosevelt Hospital Center

The frequency of bowel movements varies considerably in the general population



Diarrhea is a major cause of worldwide morbidity and mortality

- 3-5 Billion Episodes per Year
- 5 Million Deaths per Year, 80% under One Year of Age
- A Major Cause of Work Absenteeism
- A Major Economic Burden, Particularly in Developing Nations

Diarrhea is both a sign and symptom

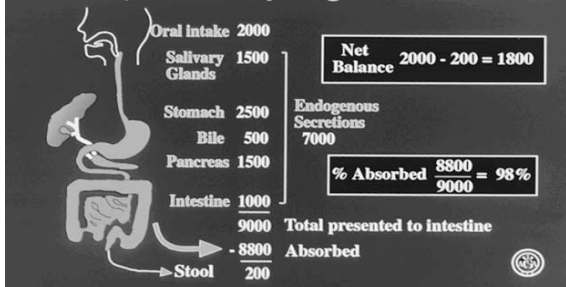
A. As a symptom:

1. ↑ Frequency
2. ↑ Volume
3. ↓ Consistency

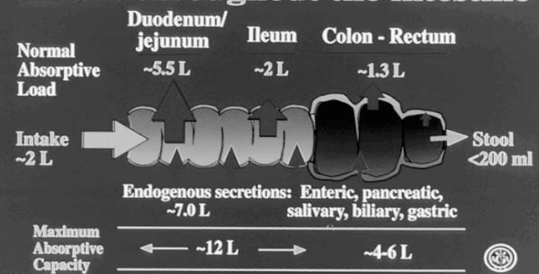
B. As a sign:

Stool weight > 150 to 200 g per 24 hr.
 (stool water > 150 to 200 ml per 24 hr.)

Daily intake and endogenous secretions are efficiently absorbed by the gastrointestinal tract



The amount of fluid absorbed differs throughout the intestine



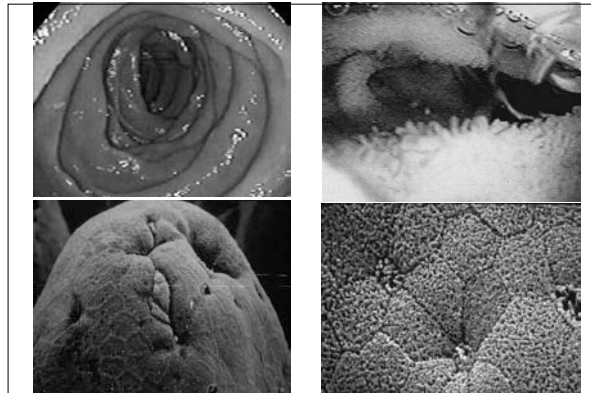
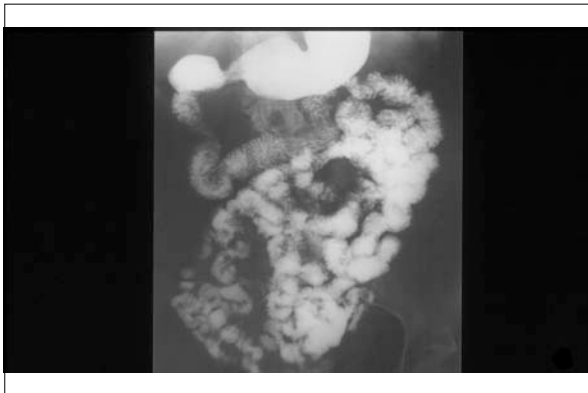
Intestinal mucosa

- Large surface area
- Stable ionic microenvironment
- Epithelial cell turnover
- Epithelial cell maturation
- Structural and functional adaptations
- Epithelial cell polarity

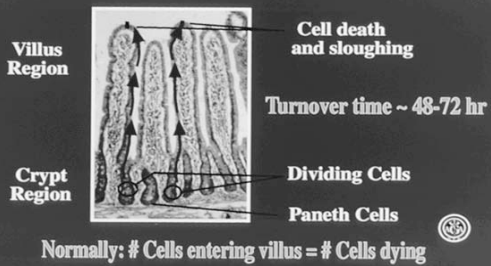
The intestine has a very large surface area for absorption

Type of Surface	Amplification Factor	Surface Area (cm ²)
Mucosal cylinder	1	3,300
Fold of Kerkring	3	10,000
Villi	10	100,000
Microvilli	20	2,000,000

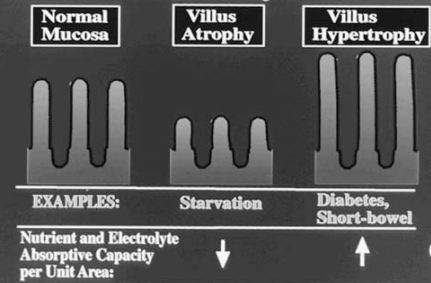
Total surface area = 200 m²
Double Tennis Court = 175 m²

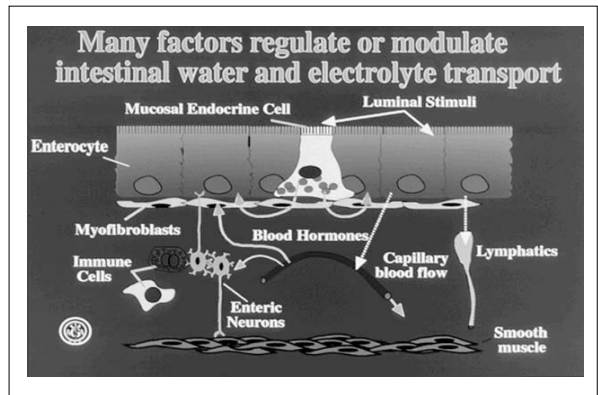
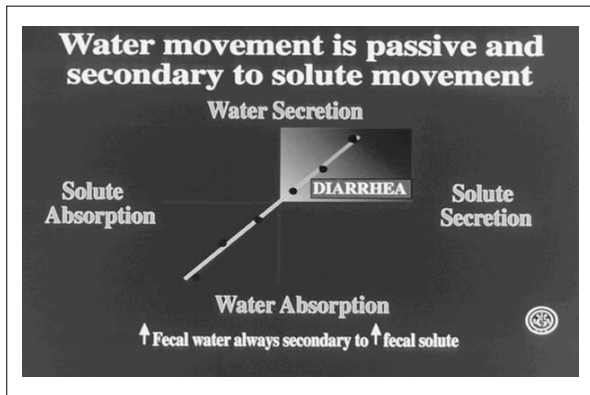
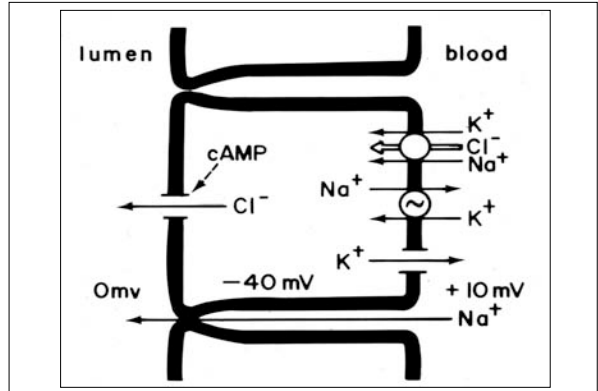
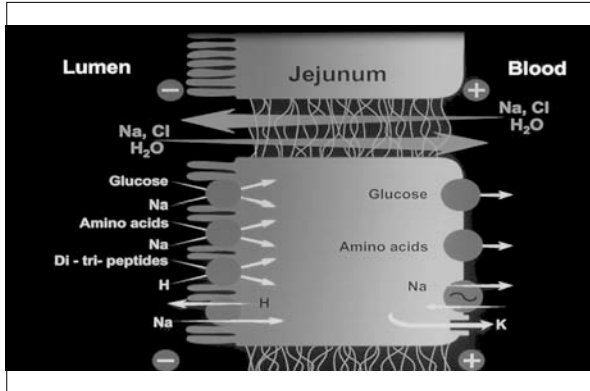


Intestinal epithelial cells are continually renewed

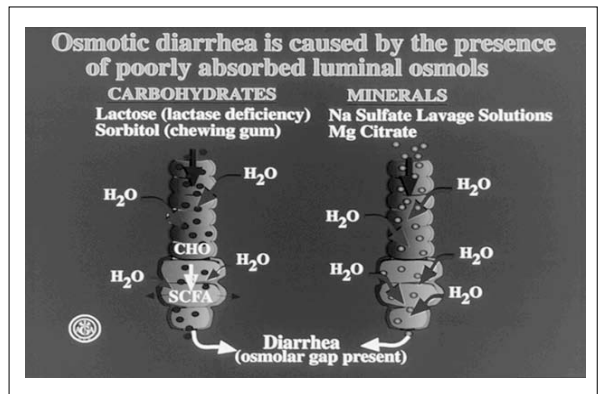


The intestinal mucosa changes with nutrient availability and disease



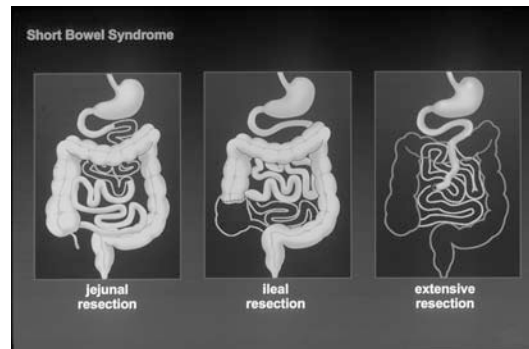


- ### Pathophysiology of diarrhea
- **Osmotic**
 - decreased surface area
 - unabsorbable solute
 - **Secretory**
 - nutrient
 - toxin
 - other mediator
 - **Mixed mechanisms**



Pathogenic mechanisms

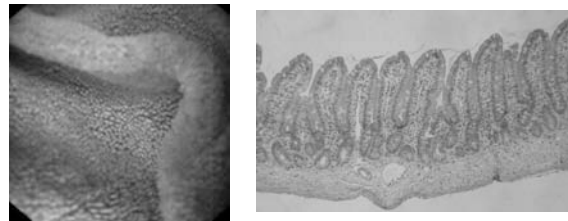
- Decreased mucosal surface area
- Ileal dysfunction
- Exudative enteropathy
- Inflammatory or tumor-associated secretagogues
- Altered motility
 - Slow transit/bacterial overgrowth
 - Rapid transit



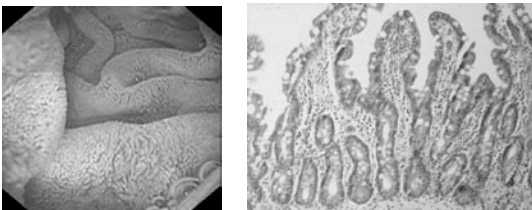
Consequences of intestinal resection

	Jejunal resection	Ileal resection
Total nutrient absorption	Normal (if <75%)	Normal
B12, bile salt absorption	Normal	Decreased
Adaptation	Normal	Decreased
Transit	Normal	Rapid

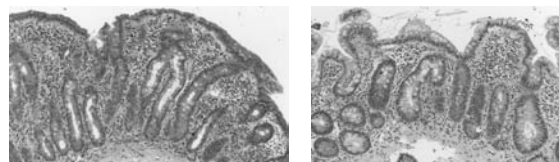
Normal mucosa



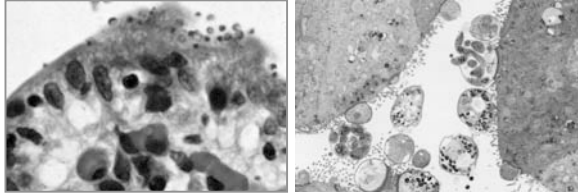
Partial villus atrophy



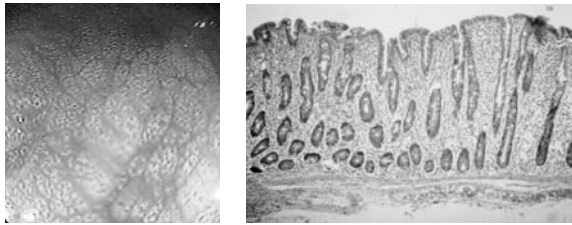
Cryptosporidiosis



Cryptosporidiosis



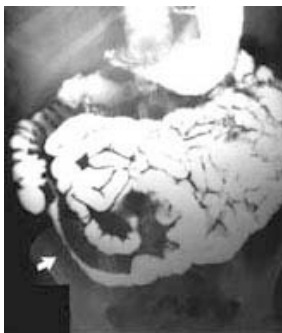
Celiac disease



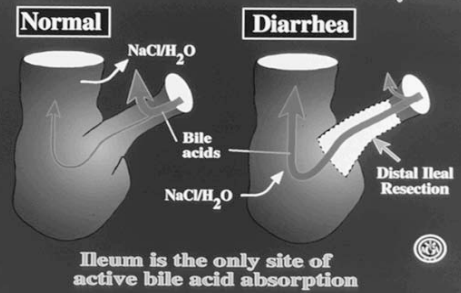
Viruses associated with gastroenteritis

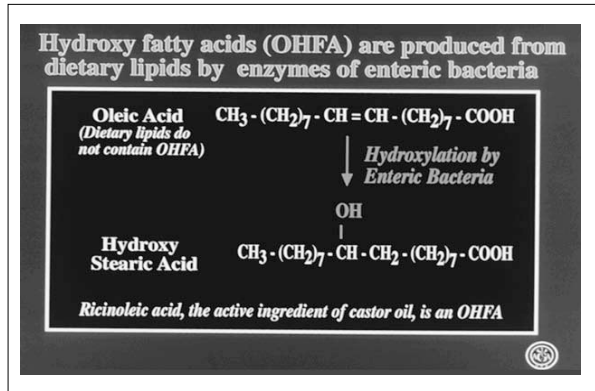
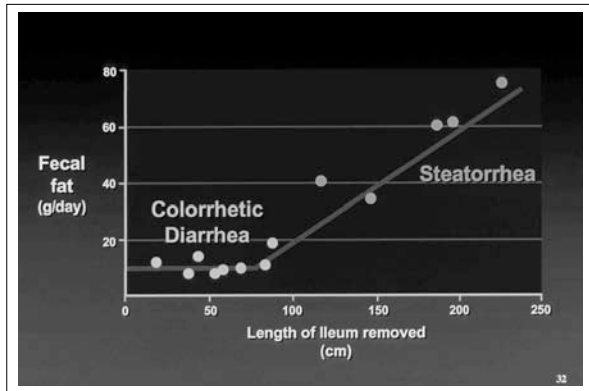
- Rotaviruses
- Adenoviruses
- Caliciviruses
- Norwalk like viruses or SRSV (Small Round Structured Viruses)
- Astroviruses
- SRV (Small Round Viruses)
- Coronaviruses
- Toroviruses

Crohn's ileitis



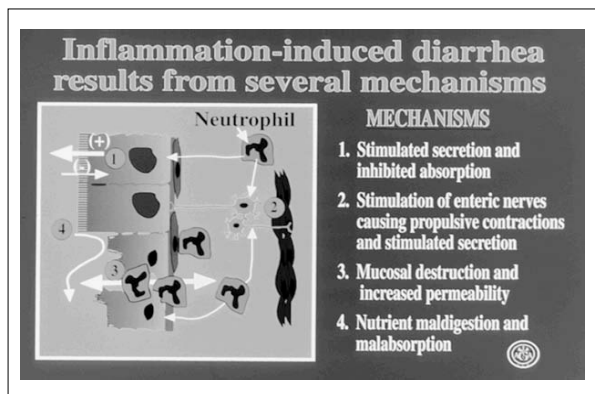
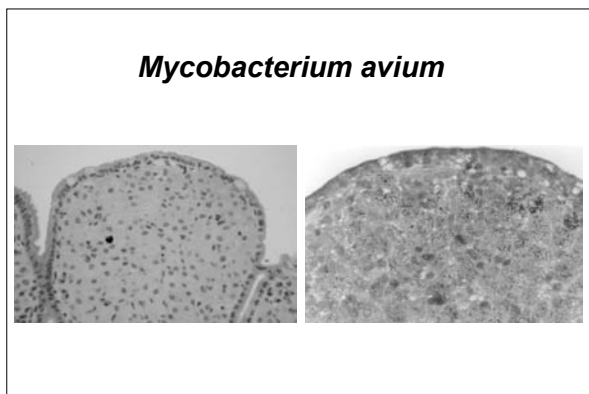
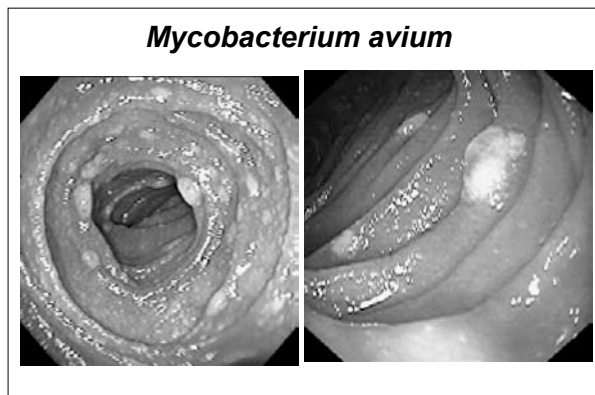
Bile acid-induced diarrhea results from ileal dysfunction



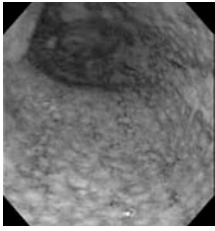


Laxatives are exogenous compounds that act similar to endogenous secretagogues

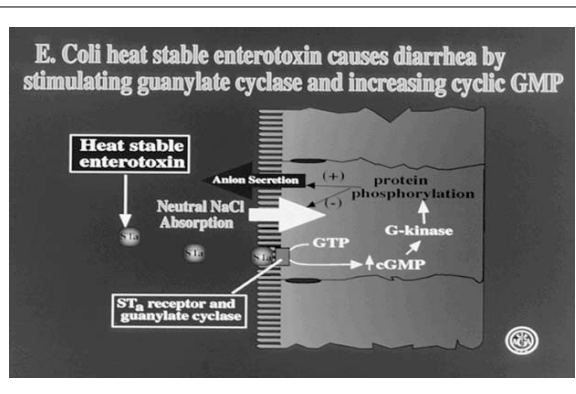
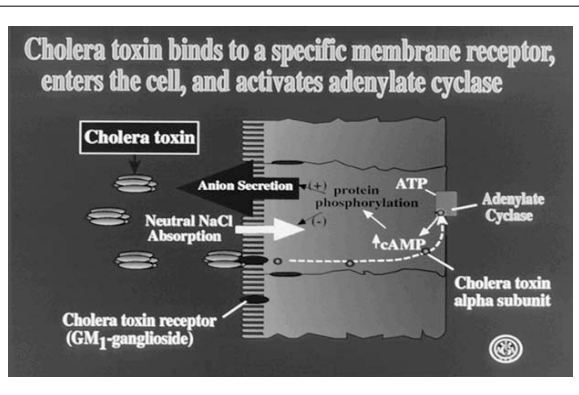
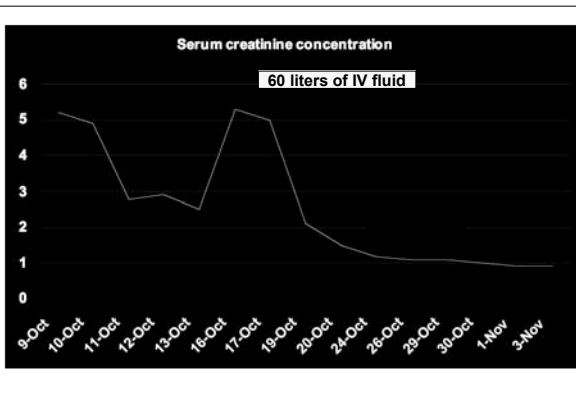
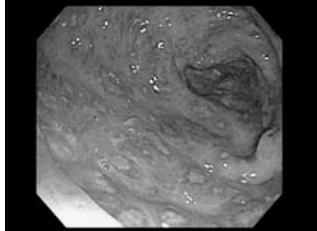
Endogenous	Exogenous
Bile Acids	Phenolphthalein
Fatty Acids	Bisacodyl
Hydroxy Stearate	Diocyl Sodium Sulfosuccinate
	Ricinoleate (in castor oil)



Ulcerative colitis

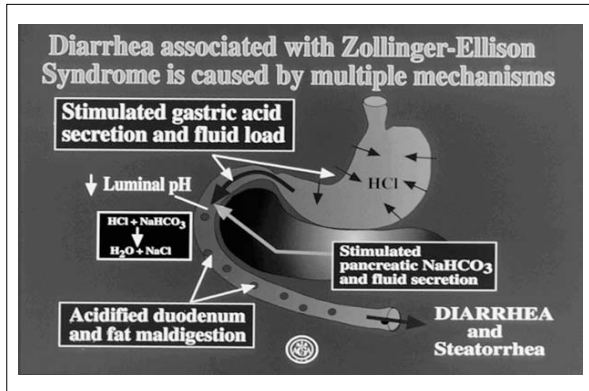


Cytomegalovirus colitis



Some secretory diarrheas are caused by hormone-producing tumors

Hormone-producing Tumor	Putative Secretagogue
1. Carcinoid	Serotonin, prostaglandins, bradykinin, tachykinins
2. VIPoma	VIP and others
3. Gastrinoma	Gastrin
4. Medullary Carcinoma of the Thyroid	Calcitonin, prostaglandins
5. Ganglioneuroma	Probably VIP

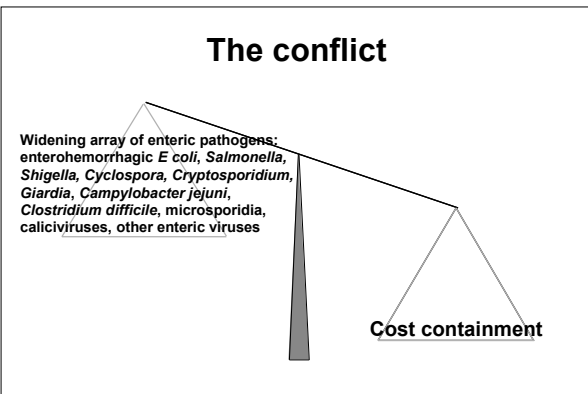


Practice guidelines for the management of infectious diarrhea

- ### Guidelines - why?
- Response to need for cost effective approach to diagnosis and management
 - Evidence-based approach
 - Identify uncertainties
 - Grades the quality of the evidence as much as the evidence itself
 - Work in progress: needs periodic revision

- ### Guidelines
- | Strength | Quality |
|---|---|
| • A - Good evidence to recommend | • I - At least 1 RCT |
| • B - Fair evidence to recommend | • II - At least 1 well-designed trial <ul style="list-style-type: none"> – not RCT |
| • C - Poor evidence to recommend for or against | – cohort, case control, dramatic uncontrolled studies |
| • D - Fair evidence to recommend against | • III - Expert opinion |
| • E - Good evidence to recommend against | |

- ### Diarrhea: magnitude of the problem
- Second leading cause of morbidity and mortality worldwide
 - >200 million cases of diarrhea per year in the US
 - 73 million physician consultations, 1.8 million hospitalizations, 3,100 deaths (mostly in the elderly)
 - Other morbidities: HUS, Guillain-Barre, malnutrition
 - Etiology hardly ever determined
 - Etiologic diagnosis usually is too late to be of clinical use in outpatients
 - Often untreated, even if diagnosis is made
 - The large majority of cases are self-limited in otherwise healthy children and adults



Etiologic diagnosis: who cares?

- **Public health: passive surveillance for common source outbreaks or serious pathogens**
- **Bioterrorism**
- **Vulnerable populations**
 - Extremes of life
 - Malnourished
 - Immune deficient

Other considerations

- **Regional and seasonal variation in the US**
- **Globalization**
- **Infections promoted by crowding and uncertain hygiene**
 - Child care
 - Schools
 - Cruise ships
- **Decreased recovery with immune deficiency: HIV, immune suppressed, post-transplant, aging**

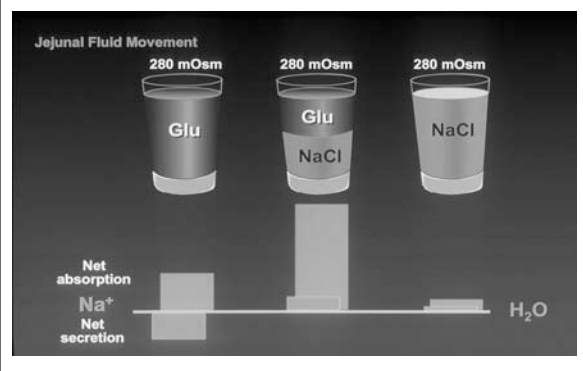
Guidelines

- **Oral rehydration**
- **Clinical and epidemiological evaluation**
- **Stool tests**
- **Antimicrobial therapy**
- **Antidiarrheals**
- **Available immunizations**



Clinical recommendations

- **Initial rehydration: ORS** **A-I**
 - available commercially
 - 3.5 gm NaCl, 2.5 gm NaHCO₃, 1.5 gm KCl, and 20 gm glucose or glucose polymer per liter of water
 - glucose can be supplied as sucrose or cooked cereal flour
 - Na 90 mM, K 20 mM, Cl 80 mM, HCO₃ 30 mM, glucose 111 mM



Composition of oral solutions

	Na	Glucose	osmolality
WHO-ORS	90	111	310
Chicken soup	250	0	450
Sports drink	20	111	145
Ginger ale	3	500	540
Apple juice	3	690	730

Na and glucose as mM, osmolality in mosm